PATENT ABSTRACTS OF JAPAN

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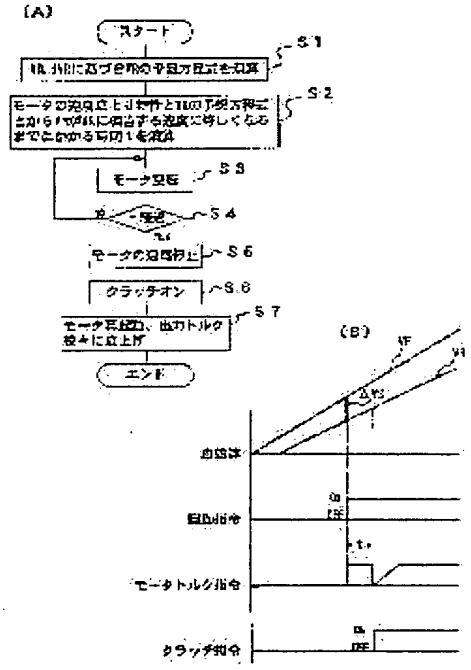
(54) MOTOR-DRIVEN DRIVING DEVICE FOR VEHICLE

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the occurrence of a shock at the time of starting to drive in a motor-driven diving device which drives an axle shaft with an electric motor via a clutch.
SOLUTION: An equation of predicting the later change of the speed of revolution VR of an axle shaft is calculated based on the speed of the revolution VF and the angular acceleration dVR of an axle shaft at the time of outputting a drive command (S1). Time t required for the speed of the revolution of an electric motor Vm to become equal to the VR is calculated from this predictive equation and the speed rising characteristics of the motor (S2). The motor is made to slip during the period of the time t (S3, S4) and a clutch is engaged with the motor temporarily switched off after the time t elapsed (S5, S6). Then, the motor is restarted to increase an output torque gradually (S7).



LEGAL STATUS

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The electromotive driving gear for vehicles characterized by starting the output torque of an electrical motor gradually in the electromotive driving gear for vehicles which drives an axle through a clutch by the electrical motor after turning on a clutch at the beginning [of an axle] of a drive.
[Claim 2] The electromotive driving gear for vehicles characterized by turning on a clutch after making an electric motor race so that it may become equal to the speed at which the rotational speed of an electrical motor is equivalent to the rotational speed of an axle before the drive of an axle in the electromotive driving gear for vehicles which drives an axle through a clutch by the electrical motor.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the electromotive driving gear for vehicles which drives an axle through a clutch by the electrical motor.
[0002]
[Description of the Prior Art] When an engine drive ring slips conventionally at the time of start on the road surface on which considers as the engine drive ring which drives one side of a vehicles order ring with an engine, and the electric driving wheel which drives another side with an electromotive driving gear, and it is easy to slide, the four hybrid formula drive vehicles which drive an electric driving wheel and assisted start are known.
[0003] The electromotive driving gear is constituted so that the output torque of an electrical motor may be transmitted to the axle of an electric driving wheel through a clutch, it carries out the energization operation of the electrical motor while it turns on a clutch, when an engine drive ring slips and drive instructions of an electric driving wheel are issued, and it is made to drive an electric driving wheel here.
[0004]
[Problem(s) to be Solved by the Invention] In the thing of the above-mentioned conventional example, the shock by the sudden standup of motor torque might occur at the beginning [of an electric driving wheel] of a drive, or the shock for the motor inertia resulting from the backlash of the power transfer system of an electromotive driving gear or the gap with axle rotational speed and motor rotational speed might occur, and there was a goods nature top problem.
[0005] this invention makes it the technical problem to offer the electromotive driving gear which enabled it to prevent shocking generating of the time of a drive in view of the above point.
[0006]
[Means for Solving the Problem] In the electromotive driving gear for vehicles which drives an axle through a clutch by the electrical motor that the above-mentioned technical problem should be solved After turning on a clutch at the beginning [of an axle] of a drive according to the 1st feature of this invention, start the output torque of an electrical motor gradually, and according to the 2nd feature of this invention It is made to turn on a clutch after making an electric motor race so that the rotational speed of an electrical motor may become equal to the speed equivalent to the rotational speed of an axle before the drive of an axle.
[0007] If the backlash of a transmission system occurs, although the shock by the motor inertia which the electrical motor was no-load at the time of a drive, rotated at it, and increased to it by sudden acceleration of an electrical motor in the meantime by the backlash by backlash will occur Since the output torque of an electrical motor is started gradually according to the 1st feature of the above, Even if backlash occurs, shocking generating which an electrical motor did not carry out sudden acceleration and originated in backlash is prevented, and shocking generating by the standup

with motor torque sudden with a natural thing is also prevented.
[0008] Moreover, although axle rotational speed is slowed down by the inertia of the electrical motor which was standing it still till then at the time of clutch-on and a shock occurs when starting a drive in the state where vehicles are not standing it still, according to the 2nd feature of the above, generating of the slowdown shock by the motor inertia at the time of clutch-on is prevented by idling of the electrical motor before clutch-on.
[0009]
[Embodiments of the Invention] With reference to drawing 1 , 1 is a front wheel on either side, 2 is a rear wheel on either side, and the four hybrid formula drive vehicles used as the engine drive ring which drives the front wheels 1 and 1 on either side through a change gear 4 with an engine 3, and the electric driving wheel which drives the rear wheels 2 and 2 on either side with the electromotive driving gear 5 are constituted.
[0010] The electromotive driving gear 5 is equipped with the dog clutch 8 interposed in the power transfer path between the differential gear 6 which connected the axles 2a and 2a of the rear wheels 2 and 2 on either side, an electrical motor 7, and an electrical motor 7 and the differential gear 6, and it is constituted so that the output torque of an electrical motor 7 may be transmitted to Wheels 2a and 2a through the dog clutch 8 and the differential gear 6. It consists of movable dog 8b to which the dog clutch 8 can engage and release fixed dog 8a of fixation in the output shaft of an electrical motor 7, and fixed dog 8a freely, and solenoid 8c which carries out engaging-and-releasing operation of the movable dog 8b to fixed dog 8b.
[0011] An electrical motor 7 and solenoid 8c are controlled by the controller 11 which inputs the signal from the ****** sensor 9 which detects the rotational speed VF of a front wheel 1, and the ****** sensor 10 which detects the rotational speed VR of a rear wheel 2. A controller 11 issues drive instructions of a rear wheel 2, when it becomes more than predetermined value **VS which a front wheel 1 slips and the speed difference of the front-wheel speed VF and the rear wheel speed VR shows to drawing 2 (B), and **** drive control shown in drawing 2 (A) is performed. In this drive control, the equation which predicts change of the after that of the rear wheel speed VR from the rotational speed VR of the rear wheel 2 in the output time of drive instructions and the angular acceleration dVR of a rear wheel 2 is calculated first (S1). Next, the time t which it will take before the rotational speed Vm of an electrical motor 7 becomes equal to the speed equivalent to the rear wheel speed VR found with the above-mentioned prediction equation based on the speed rising characteristic of the during starting of an electrical motor 7 is calculated (S2), and only this time t races an electrical motor 7 (S3, S4). And while stopping the energization to an electrical motor 7 in the place where Time t has passed since the output time of drive instructions (S5), movable dog 8b is made to engage with fixed dog 8a by the energization to solenoid 8c, and the dog clutch 8 is turned on (S6). Then, an electrical motor 7 is rebooted and the output torque is started gradually (S7).
[0012] According to this, the rotational speed of an electrical motor 7 is rising to the speed equivalent to the rear wheel speed VR, a rear wheel 2 does not receive the slowdown force by the inertia of an electrical motor 7 at the ON time of the dog clutch 8 at the time of ON of the dog clutch 8, and generating of a slowdown shock is prevented. In addition, if the rear wheel 2 is standing it still at the output time of drive instructions, it will be set to t= 0, and the dog clutch 8 is turned on immediately, without racing an electrical motor 7.
[0013] Moreover, if an electrical motor 7 is no-load by the backlash by the backlash of the power transfer system between wheel 2a, it rotates on the occasion of the reboot of the electrical motor 7 after ON of the dog clutch 8 and the sudden acceleration of the electrical motor is carried out between them, a rear wheel 2 will receive the acceleration force by the motor inertia which increased by sudden acceleration at the moment of backlash being removed and the torque transmission to a rear wheel 2 being started, and an acceleration shock will occur. However, since the output torque of the electric motor 7 is gradually started like the above on the occasion of the

reboot of an electrical motor 7, the sudden acceleration of the electrical motor 7 is not carried out by the no-load rotation for backlash by backlash, generating of an acceleration shock is prevented, and shocking generating by subsequent sudden acceleration is also prevented.
[0014] By the way, although the idling time t was computed by having predicted change of the rear wheel speed VR with the above-mentioned operation gestalt, it is also possible to detect the rotational speed of an electrical motor 7, and to turn on the dog clutch 8, when it goes up at the speed at which the rotational speed is equivalent to the rear wheel speed VR in the time with idling of an electrical motor 7. However, in the thing of the above-mentioned operation gestalt, since the speed sensor for electrical-motor 7 becomes unnecessary, it is advantageous in cost.
[0015] As mentioned above, although the operation gestalt which applied this invention to the four hybrid formula drive vehicles which use a front wheel 1 an engine drive ring, and use a rear wheel 2 as an electric driving wheel was explained, this invention is applicable also like the four hybrid formula drive vehicles which use a rear wheel 2 an engine drive ring, and use a front wheel 1 as an electric driving wheel.
[0016]
[Effect of the Invention] According to this invention, shocking generating of the time of a drive is prevented and goods nature can be improved so that clearly from the above explanation.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing an example possessing this invention equipment of vehicles
[Drawing 2] (A) The flow chart which shows the content of control of an electromotive driving gear, the timing diagram which shows the operation timing of the (B) motor or a clutch
[Description of Notations]
2a Axle 4 Electromotive driving gear 7 Electrical motor
8 Dog Clutch 11 Controller

[Translation done.]

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Ｂ６０Ｋ　17/356		Ｂ６０Ｋ　17/356	

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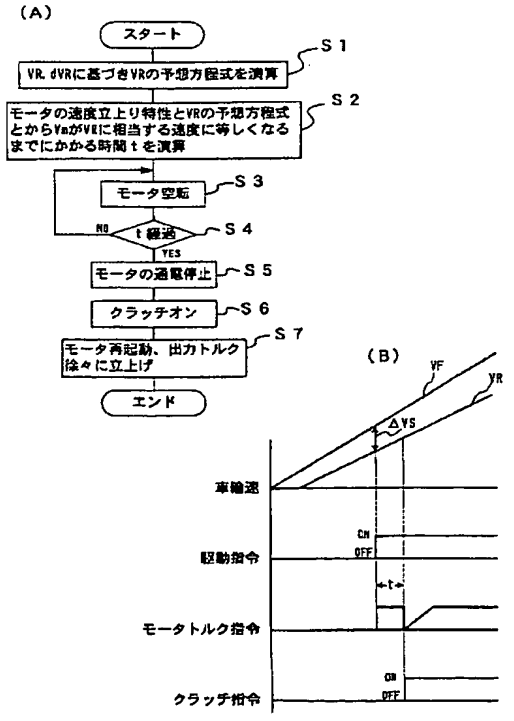
(54)【発明の名称】　車両用電動式駆動装置

(57)【要約】

【課題】　車軸をモータによりクラッチを介して駆動する電動式駆動装置において、駆動当初のショックの発生を防止する。

【解決手段】　駆動指令の出力時点での車軸の回転速度ＶＲと角加速度ｄＶＲとに基づいて車軸速度ＶＲのその後の変化を予測する方程式を演算し（Ｓ１）、この予測方程式とモータの速度立上り特性とからモータ回転速度ＶｍがＶＲに相当する速度に等しくなるまでにかかる時間ｔを演算する（Ｓ２）。モータをｔの間空転し（Ｓ３，Ｓ４）、ｔ経過後にモータの通電を一時停止した状態でクラッチをオンし（Ｓ５，Ｓ６）、その後モータを再起動して出力トルクを徐々に立上げる（Ｓ７）。



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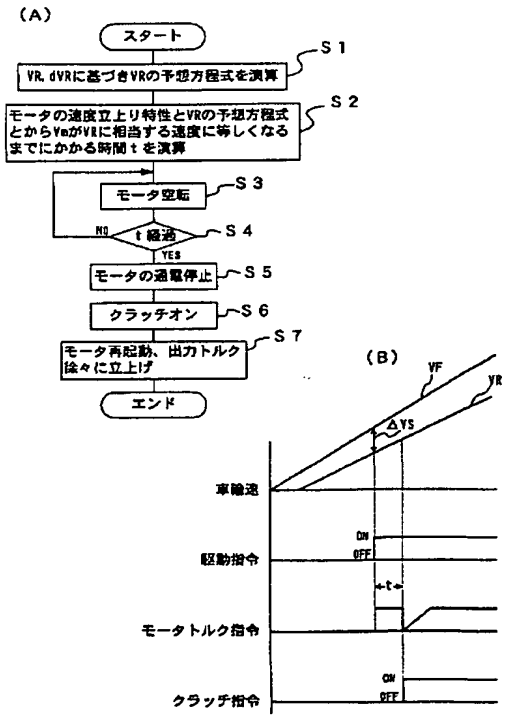


電を一旦停止すると共に（Ｓ５）、ソレノイド８ｃへの通電で可動ドグ８ｂを固定ドグ８ａに係合させてドグクラッチ８をオンする（Ｓ６）。その後、電動モータ７を再起動してその出力トルクを徐々に立上げる（Ｓ７）。

【００１２】これによれば、ドグクラッチ８のオン時点において電動モータ７の回転速度は後輪速度ＶＲに相当する速度まで上昇しており、ドグクラッチ８のオン時に後輪２が電動モータ７のイナーシャによる減速力を受けることがなく、減速ショックの発生が防止される。尚、駆動指令の出力時点で後輪２が静止していればｔ＝０となり、電動モータ７を空転せずに直ちにドグクラッチ８がオンされる。

【００１３】また、ドグクラッチ８のオン後の電動モータ７の再起動に際し、電動モータ７は車輪２ａとの間の動力伝達系のバックラッシュによるガタ分だけ無負荷で回転し、その間に電動モータが急加速されると、ガタが除去されて後輪２へのトルク伝達が開始される瞬間に後輪２が急加速で増加したモータイナーシャによる加速力を受け、加速ショックが発生する。然し、電動モータ７の再起動に際しては、上記の如く電動モータ７の出力トルクを徐々に立上げているため、バックラッシュによるガタ分の無負荷回転で電動モータ７が急加速されることはなく、加速ショックの発生が防止され、その後の急加速によるショックの発生も防止される。

【００１４】ところで、上記実施形態では、後輪速度ＶＲの変化を予測して空転時間ｔを算出したが、電動モータ７の回転速度を検出して、電動モータ７の空転によりその回転速度がその時点での後輪速度ＶＲに相当する速度に上昇したときにドグクラッチ８をオンすることも可能である。然し、上記実施形態のものでは電動モータ７用の速度センサが不要になるため、コスト的に有利である。

【００１５】以上、前輪１をエンジン駆動輪、後輪２を電動駆動輪とするハイブリッド式４輪駆動車両に本発明を適用した実施形態について説明したが、後輪２をエンジン駆動輪、前輪１を電動駆動輪とするハイブリッド式４輪駆動車両にも同様に本発明を適用できる。

【００１６】

【発明の効果】以上の説明から明らかなように、本発明によれば、駆動当初のショックの発生を防止して商品性を向上できる。

【図面の簡単な説明】

【図１】　本発明装置を具備する車両の一例を示す図

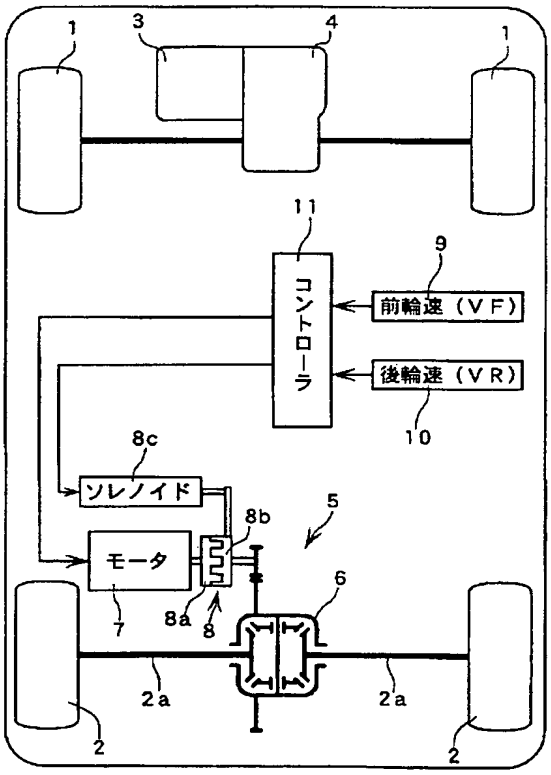
【図２】　（Ａ）電動式駆動装置の制御内容を示すフローチャート、（Ｂ）モータやクラッチの作動タイミングを示すタイムチャート

【符号の説明】

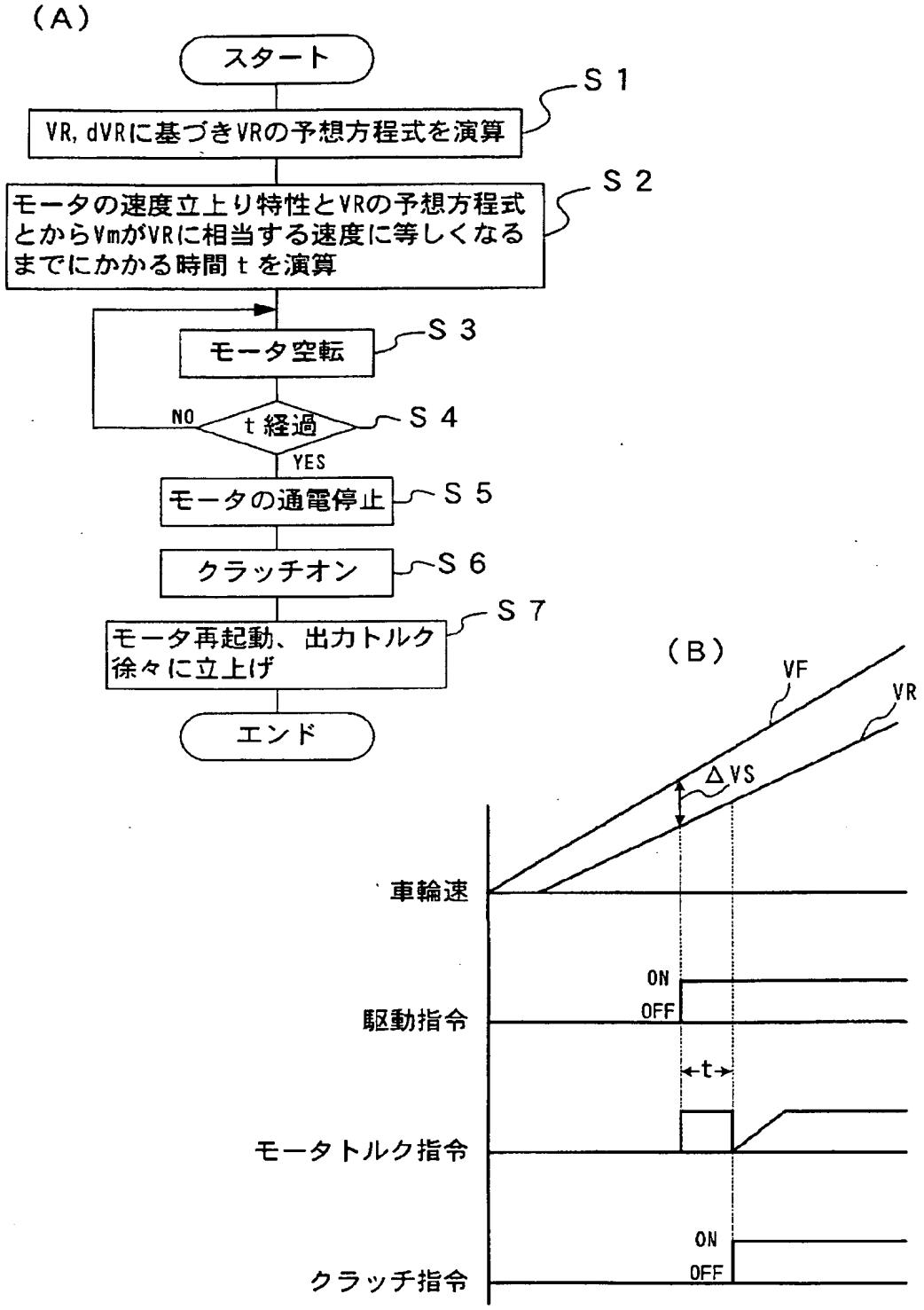
２ａ　車軸　　４　電動式駆動装置　　７　電動モータ

８　ドグクラッチ　　１１　コントローラ

【図１】



【図２】


（Ａ）
スタート
S１
VR, dVRに基づきVRの予想方程式を演算
S２
モータの速度立上り特性とVRの予想方程式とからVmがVRに相当する速度に等しくなるまでにかかる時間ｔを演算
S３
モータ空転
NO
ｔ経過
S４
YES
S５
モータの通電停止
S６
クラッチオン
S７
モータ再起動、出力トルク徐々に立上げ
エンド
（Ｂ）
VF
VR
ΔVS
車輪速
ON
OFF
駆動指令
t
モータトルク指令
ON
OFF
クラッチ指令